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BIOLOGICAL EVALUATION
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GYPSY MOTH
Detection Trapping
on
National Forest System Lands
in the
Rocky Mountain Region

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INTRODUCTION

The Gypsy Moth (*Lymantria dispar* L.), initially a pest of European countries, was introduced into America in 1869 by Leopold Trouvelot, a French naturalist. As a hobby, Mr. Trouvelot studied wild silk-worms. He hoped, through cross-breeding different species, to produce a hardier insect than the silk-worm of commerce and one that would feed on trees other than mulberry (Forbush and Fernald, 1896)

Remember, the tenets of biology were not well understood in 1869. Besides lacking an understanding of speciation, it seems that Trouvelot had little knowledge of the gypsy moth beyond the fact that the color and appearance of the adults were similar to the silk-worm. Had he known that the gypsy moth spins no cocoon, it is unlikely that he would have bothered to obtain egg clusters from Europe.

When the eggs hatched at his home in Medford, Massachusetts in 1869, Trouvelot placed the larvae on a shrub in his yard, only taking the precaution of covering them with a cheesecloth net. When the net was torn during a storm, he attempted to retrieve all the caterpillars and published an announcement of their escape. The matter was soon forgotten (Forbush and Fernald, 1896).

The first time anyone in the United States realized the seriousness of the threat posed by the gypsy moth was during the summer of 1889 - twenty years after their escape. Prominent citizens of Medford stated:

> ". . .worms were so numerous that one could slide on the crushed bodies on the side walks. . . "
>
> ". . .the insects crowded each other off the trees and gathered in masses on the ground, fences, and houses; entering windows, destroying flowering plants and even appearing in the chambers at night."

The myriads that were crushed under foot on the sidewalks of the town gave the streets a filthy appearance. In the warm, still summer nights, a sickening odor arose from the masses of caterpillars and pupae in the woods and orchards, and a constant shower of excrement fell from the trees (Forbush and Fernald, 1896).

It was this outbreak and others of equal proportion that prompted the intensive study of this pest and the search for methods to control it.

Today, a century after the first outbreak, the gypsy moth has spread throughout the eastern seaboard from Quebec to North Carolina. Small infestations also occur in at least 14 states including Colorado and moths have been captured in all but a few states.

We have learned a lot about the gypsy moth during the last one hundred years. We know, for example, that the larvae can feed on over 500 species of trees, shrubs and vines. Among its favored foods are oak and aspen.

REGIONAL IMPLICATIONS

Today, in Europe and in much of New England, the gypsy moth merely is a nuisance and does not kill large numbers of trees, but this is not the situation when the gypsy moth moves into a new area. Historical records from New England and current data from New Jersey and Pennsylvania show that tree mortality is often extensive (USDA, 1979).

On National Forest System Lands in our Region, this insect poses its greatest threat to our 2 million acres of aspen and 300,000 acres of oak woodland. Although the magnitude of this threat cannot be precisely determined, lower elevation aspen stands associated with gambel oak would probably be at greatest risk.

In addition to the potential impact on our forest resource, the socio-political interest this insect attracts whenever it occurs cannot be overstated. Quarantines restricting the movement of household goods, nursery stock, and some forest products from infested areas are additional socio-economic hardships associated with this insect. The cost of early detection and prevention of isolated infestations are minor compared to the cost of dealing with the insect after it becomes established.

BIOLOGY OF THE GYPSY MOTH

The gypsy moth has one generation per year. In Colorado (Fort Collins), larvae begin to emerge from egg masses between late April and mid-May (Leatherman, 1988). The time of hatch is determined by temperature and usually coincides with budbreak of many hardwoods.

Within several days of hatching, larvae leave the egg mass and climb trees or other objects, trailing silken threads continuously as they move. When the larvae reach the top or perimeter of the object they have climbed, they do not feed. Instead, they drop on silken threads and are then dispersed by the slightest gust of wind in a process called "ballooning". By ballooning, larvae may be carried long distances but most are distributed within relatively local areas (McManus, 1980).

These larval leaf-eating machines (Fig. 1) complete their development by early July, pupate, and remain in the pupal stage (Fig. 2) for about two weeks. Male moths (Fig. 3) usually emerge from their pupae before females and are strong fliers. Female moths have wings but do not fly - they can only crawl short distances from the place they emerged.

Soon after emerging from the pupa, the female moth releases a sex attractant (pheromone) which attracts male moths. In our detection effort, we exploit this behavior by "baiting" our traps with this pheromone in order to capture lonely males.

After mating, the female deposits a single buff-colored egg mass (Fig. 4) which contains 75 to 1000 eggs. Within 4 to 6 weeks, the embryos develop into larvae that overwinter in the eggs and hatch the following spring.

It is important to note that because larvae defoliate trees during the first half of the summer, severely defoliated hardwoods often produce a second flush of leaves. The production of a second set of leaves in a growing season can deplete a trees' food reserves which are stored as starches in the roots. Reduced starch reserves can make a tree more vulnerable to drought stress or attack by diseases or other insects.

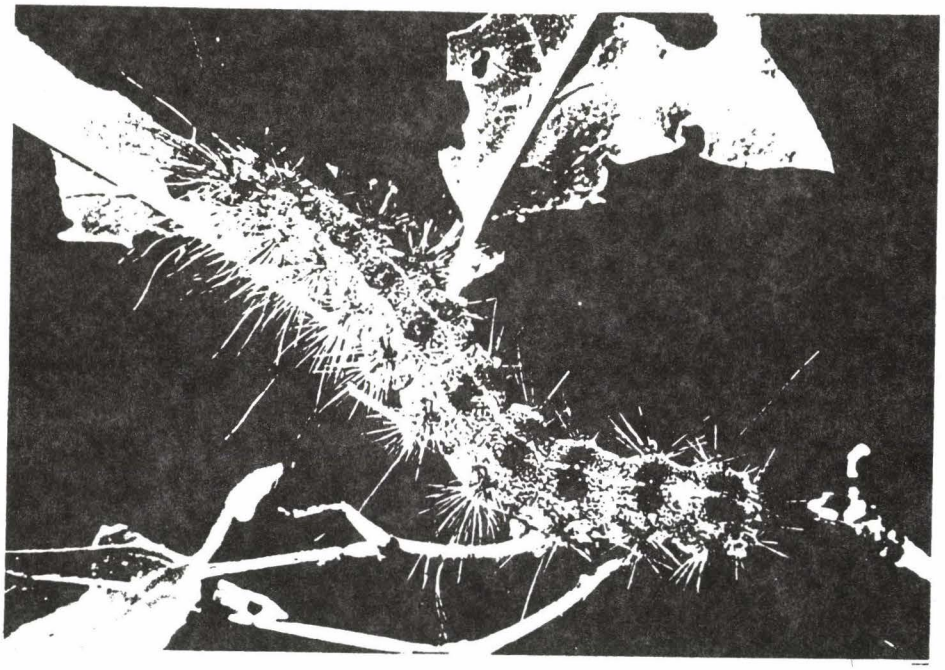

Fig. 1. Mature larva of gypsy moth

Fig. 2. Gypsy moth pupae

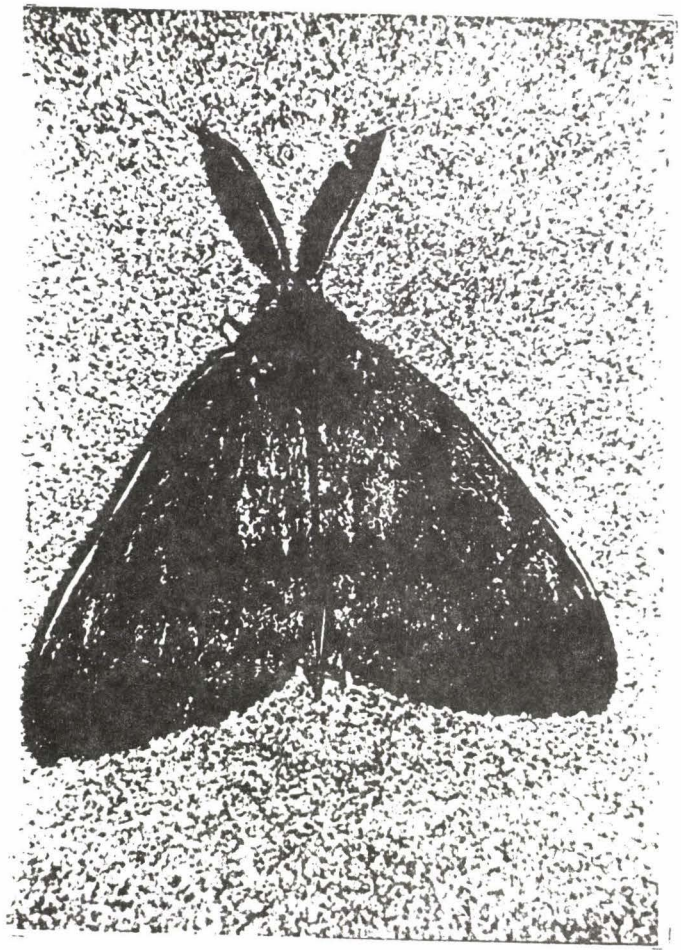

Fig. 3. Adult male gypsy moth.

Fig. 4. Adult female gypsy moths depositing egg masses.

DETECTION TRAPPING IN THE REGION

Certainly the gypsy moth has not ballooned its way from the eastern seaboard to distant states such as Oregon, Utah or Colorado. So how does it travel all those miles to start new infestations in the Rockies or Pacific Northwest?

For years we have known that most isolated infestations of the gypsy moth are started from egg masses transported from infested areas on outdoor household articles, campers, vehicles, and any other items that provide accessible, protected sites for the female at egg laying time.

Since the recreation areas of our Region attract visitors from everywhere in the country, who bring many of the aforementioned items with them, much of our gypsy moth detection effort has been focused on these areas.

Considering the biology of the insect (hatch around mid-May) and the date we open most of our developed recreation sites (Labor Day weekend), most of the gypsy moths brought to our campgrounds will be in either the larval or pupal stages. Introductions of these stages are less likely to develop into an infestation than the introduction of egg masses. Yet the introduction of larvae or pupae may still result in the start of an isolated infestation particularly if suitable gypsy moth host material is present near the point of introduction.

Forest Pest Management has been coordinating gypsy moth detection trapping on National Forest System Lands since 1982. From 1982-1987, trapping sites were randomly selected from all recreation sites with suitable gypsy moth habitat. Recently, we decided to refine this approach and to concentrate our detection efforts on those areas where isolated infestations were most likely to begin. In 1988, 5 criteria were used to select trapping sites and we began a more structured gypsy moth detection program.

CRITERIA USED TO SELECT GYPSY MOTH TRAPPING SITES ON THE NATIONAL FOREST SYSTEM LANDS

A list of sites meeting the following criteria was prepared with the help of the timber and recreations staffs of the 12 National Forests in the Region.

A. Recreation sites in or adjacent to stands having a hardwood component or containing woody shrubs

and

1. Support greater than 5,000 recreation visitor days (RVD's) of general, auto and trailer camping per year. Examples are sites along travel corridors to Yellowstone National Park, Mount Rushmore National Monument, Rocky Mountain National Park, Colorado National Monument, Mesa Verde National Park, etc.

or

2. are likely to be visited in the Spring by people from the generally infested areas. Examples are sites on NFS lands adjacent to fishing areas, lodges, religious retreats, summer camps, etc.

or

3. are near year-round resorts. Examples are campgrounds and picnic areas near Aspen, Vail, and Keystone

or

4. are near residential areas with mobile or seasonal populations. Examples are sites near summer home groups on NFS lands and residential areas with resorts.

A list of sites meeting the above criteria can be found in Appendix A.

RESULTS

In 1988, our detection efforts resulted in the first capture of a gypsy moth on National Forest System Lands in our Region. One moth was caught in a trap placed at the Eagle Creek Campground on the Wapiti District of the Shoshone National Forest. Traps had been placed at this site each year since 1986. Two traps were placed in this campground in 1988.

Eagle Creek Campground is located along Highway 20 which is the main route from Cody to the east entrance of Yellowstone National Park. The site is approximately eight miles from the park entrance; less than a quarter of a mile from the Eagle Creek summer home area; and less than 3 miles from 2 other summer home areas, a lodge and a boy scout camp. The campground lies in a riparian zone containing cottonwoods and other hardwood shrubs; has 20 camping units; and supports approximately 20,000 recreation visitor days per year. The campground opens on Memorial Day weekend and is full every night during July and August. In short, the Eagle Creek Campground met most of the detection site selection criteria.

FUTURE PLANS

In 1989, we will make a greater effort toward insuring that traps are deployed on all sites on National Forest System Lands which meet the selection criteria. Also, we will strive to do a better job of labelling the traps with precise information about where they were placed. At the end of the summer, *all* traps will be submitted to the Regional Office even if they do not contain insects. This will allow us to better document our trapping effort.

At the Eagle Creek Campground, more intensive trapping will be done. If additional moths are caught at this site in 1989, a search for other gypsy moth life stages will be conducted in the Fall. If additional life stages are subsequently found a delimitation survey will be done and alternatives for controlling the insect will be developed.

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APPENDIX A
1988 GYPSY MOTH DETECTION SURVEY SITES

Forest	*Site*	*Location*		
		T	*R*	*S*
Arapaho/Roosevelt	Dowdy Lake	10N	73W	35
Arapaho/Roosevelt	Bellaire Lake	10N	73W	6
Arapaho/Roosevelt	Aspen Glen	6N	77W	4
Arapaho/Roosevelt	Big South	8N	75W	28
Arapaho/Roosevelt	Kelly Flats	8N	72W	8
Arapaho/Roosevelt	Mountain Park	8N	72W	9
Arapaho/Roosevelt	Dutch George Flats	8N	72W	4
Arapaho/Roosevelt	Narrows Coop	8N	72W	3
Arapaho/Roosevelt	Upper Landing	6N	75W	26
Arapaho/Roosevelt	Stove Prarie Landing	8N	72W	12
Arapaho/Roosevelt	Diamond Rock	8N	71W	3
Arapaho/Roosevelt	Poudre Park	8N	71W	2
Arapaho/Roosevelt	Lower N. Fork Thompson	6N	72W	26
Arapaho/Roosevelt	Upper N. Fork Thompson	6N	72W	28
Arapaho/Roosevelt	Glen Haven	6N	72W	28
Arapaho/Roosevelt	Crow Valley	8N	62W	12
Arapaho/Roosevelt	West Chicago Lake	4S	74W	27
Arapaho/Roosevelt	Columbine	2S	73W	3
Arapaho/Roosevelt	Pickle Gulch	2S	73W	26
Arapaho/Roosevelt	Cold Springs R.A.	2S	72W	30
Arapaho/Roosevelt	Olive Ridge	3N	73W	23
Arapaho/Roosevelt	South St. Vrain	3N	71W	33
Arapaho/Roosevelt	Peaceful Valley	2N	73W	13
Bighorn	North Fork P.G.	50N	84W	10
Bighorn	Hunter Creek Corrals	50N	84W	3
Bighorn	Tensleep Creek	48N	87W	34
Bighorn	Girl Scout Nat'l Ctr. West	55N	88W	7
Bighorn	Tyrell R.S.	55N	88W	6
Bighorn	Prune Creek	55N	88W	4
Bighorn	North Tongue River	55N	88W	1
Bighorn	Story Fish Hatchery	56N	89W	5
Bighorn	Bradford Brinton Memorial	55N	88W	8
Black Hills	Reuter C.G.	51N	63W	9
Black Hills	Cook Lake P.G.	53N	63W	10
Black Hills	Bismarch Lake C.G.	3S	5E	21
Black Hills	Comanche Park C.G.	4S	3E	2
Black Hills	Harry Mills P.G.	4S	3E	1
Black Hills	Dutchman C.G.	1N	3E	29
Black Hills	Horsethief Lake C.G.	2S	5E	11
Black Hills	Oreville C.G.	2S	4E	14
Black Hills	Whitetail C.G.	1N	3E	30
Black Hills	Willow Creek G.A.	2S	5E	9
Black Hills	Harney R.S.	1S	5E	30

Forest	*Site*	*Location*		
		T	*R*	*S*
Black Hills	Roubaix Lake C.G.	3N	4E	20
Black Hills	Custer Crossing P.G.	3N	4E	17
Black Hills	Pactola C.G.	1N	5E	10
Black Hills	Sheridan Lake	1S	5E	1
Black Hills	North Cove G.A.	1S	5E	1
Black Hills	Bear Gulch C.G.	1N	5E	2
Black Hills	Sheridan Northside C.G.	1N	5E	4
Black Hills	Sheridan Southside C.G.	1N	5E	4
Black Hills	Pactola Point P.G.	2N	5E	4
Black Hills	Pactola Visitor Ctr	1N	5E	2
Black Hills	Jenny Gulch C.G.	2N	5E	32
Black Hills	Iron Mountain P.G.	2S	6E	30
Black Hills	Pactola R.S.	2N	5E	4
GMUG	Sunshine C.G.	42N	9W	20
GMUG	Amphitheatre C.G.	44N	7W	32
GMUG	Pitkin C.G.	50N	82W	10
GMUG	Rosy Lane	15S	83W	2
GMUG	Lottis	15S	83W	2
GMUG	Cement	14S	85W	24
Medicine Bow	Forest Headquarters	15N	73W	4
Medicine Bow	Upper Tie City C.G.	15N	72W	26
Medicine Bow	Upper Tie City C.G.	15N	72W	26
Medicine Bow	Pole Creek C.G.	15N	72W	24
Medicine Bow	Pole Creek C.G.	15N	72W	24
Medicine Bow	Vedauwoo P.G.	14N	71W	29
Medicine Bow	Vedauwoo P.G.	14N	71W	29
Medicine Bow	Willow C.G.	16N	78W	28
Medicine Bow	Willow C.G.	16N	78W	28
Nebraska	Red Cloud	31N	48W	6
Nebraska	Cliffs	32N	50W	7
Nebraska	Access to Soldier Cr. Wild.	32N	53W	32
Nebraska	Roberts Tract	31N	52W	7
Nebraska	Pine Ridge	31N	52W	12
Nebraska	Black Hill Overlook	30N	53W	8
Nebraska	Bessey RD	22N	26W	11
Nebraska	Steer Creek	31N	33W	2
Nebraska	Morton Admin. Site	33N	32W	30
Pike/San Isabel	O'Haver Lake			
Pike/San Isabel	Monarch Pass			
Pike/San Isabel	Bear Lake C.G.			
Pike/San Isabel	Blue Lake C.G.			
Pike/San Isabel	Cuchara	31S	69W	21
Pike/San Isabel	Cascade	15S	79W	29
Pike/San Isabel	Cottonwood Lake	14S	79W	31
Rio Grande	Palisade C.G.	41N	2E	33
Rio Grande	Beaver Creek C.G.	39N	2E	20
Rio Grande	Big Meadows C.G.	38N	2E	17
Rio Grande	Elk Creek C.G.	33N	5E	1

Forest	Site	Location T	R	S
Routt	Meadows C.G.	5N	83W	21
Routt	Dumont Lake C.G.	5N	83W	8
Routt	Hinman C.G.	9N	84W	8
Routt	Seedhouse C.G.	9N	84W	2
Routt	Walton Creek C.G.	5N	83W	23
Routt	Hahns Peak Lake P.G.	10N	86W	11
San Juan	Vallecito Lake	37N	6W	16
San Juan	Lower Piedra C.G.	34N	4W	5
San Juan	Cherry Creek P.G.	36N	11W	31
San Juan	East Fork C.G.	36N	1E	7
San Juan	Wolf Creek C.G.	37N	1E	16
San Juan	Bridge C.G.	37N	3W	4
San Juan	McPhee C.G.	38N	15W	
San Juan	Forks C.G.	38N	14W	36
San Juan	Cayton C.G.	41N	10W	33
San Juan	Miller Creek C.G.	36N	7W	8
San Juan	Florida R.A.	37N	7W	19
San Juan	Transfer Park C.G.	37N	7W	19
San Juan	Pine River C.G.	37N	6W	26
San Juan	Middle Mountain C.G.	36N	6W	4
San Juan	Pine Point C.G.	36N	6W	9
San Juan	Graham Creek C.G.	36N	6W	16
San Juan	North Canyon C.G.	36N	6W	16
San Juan	Old Timers C.G.	36N	6W	20
San Juan	Williams Creek C.G.	37N	3W	30
San Juan	Haviland Lake C.G.	38N	9W	25
San Juan	Chris Park C.G.	38N	9W	36
San Juan	Purgatory C.G.	39N	9W	24
San Juan	South Mineral C.G.	41N	8W	17
San Juan	Junction Creek R.A.	36N	10W	36
San Juan	Mavreeso C.G.	39N	13W	9
San Juan	Thompson Park C.G.	36N	12W	33
Shoshone	Fox Creek C.G.	58N	107W	30
Shoshone	Crazy Creek C.G.	57N	107W	10
Shoshone	Wapiti C.G.	52N	106W	21
Shoshone	Newton Creek C.G.	52N	107W	29
Shoshone	Eagle Creek C.G.	52N	108W	17
Shoshone	Three Mile C.G.	52N	109W	11
Shoshone	Pahaska C.G.	52N	109W	3
Shoshone	Falls C.G.	43N	109W	7-8
Shoshone	Sinks C.G.	32N	1W	19
Shoshone	Dead Indian C.G.	55N	104W	9
White River	Difficult	11S	84W	33
White River	Maroon River	11S	85W	13
White River	South Fork	2S	90W	19
White River	Bogan Flats	11S	88W	18
White River	Ruedi C.G.	75S	84W	8
White River	Gore Creek	5S	79W	7
White River	Blue River	3S	78W	4